

PROJECT DATA

Nanomix, Inc. - 03GO13169

Carbon Dioxide Nanoelectric Sensors

<p>Recipient: Nanomix, Inc.</p> <p>Recipient Project Director: Jeff D. Wyatt 510.428.5302 5980 Horton Street, Suite 600 Emeryville, CA 94608</p> <p>Recipient Type: For Profit Organization</p> <p>Subcontractor(s):</p> <p>EERE Program: Building Technologies</p>	<p>Instrument Number: DE-FG36-03GO13169</p> <p>CPS Number: 17829</p> <p>HQ Program Manager: Lisa Barnett 202.586.2212</p> <p>GO Project Officer: Gibson Asuquo 303.275.4910</p> <p>GO Contract Specialist: Melissa Wise 303.275.4907</p> <p>B&R Number(s): ED1906020</p> <p>PES Number(s): 03-10157</p> <p>State Congressional District: CA - 9</p>
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PROJECT SCOPE: The objective of this project is to develop a nanoelectronic carbon dioxide sensor for ventilation control in building HVAC systems. The sensor is based on carbon nanotube transducers fabricated on silicon chips that are coded to respond to carbon dioxide molecules. The resulting nanosensor chip features state-of-the-art performance in a tiny package that consumes very little power.

FINANCIAL ASSISTANCE

Approved DOE Budget:	\$75,000	Approved DOE Share:	\$75,000
Obligated DOE Funds:	\$75,000	Cost Share:	\$74,896
Remaining Obligation:	\$0		
Unpaid Balance:	\$54,793	TOTAL PROJECT:	\$149,896

Project Period: 9/30/03-9/30/04

TECHNICAL PERFORMANCE
DE-FG36-03GO13169
Nanomix, Inc.
Carbon Dioxide Nanoelectric Sensors

PROJECT SYNOPSIS

The objective of this project is to develop a nanoelectronic carbon dioxide sensor for ventilation control in building HVAC systems. The sensor is based on carbon nanotube transducers fabricated on silicon chips that are coded to respond to carbon dioxide molecules. The resulting nanosensor chip features state-of-the-art performance in a tiny package that consumes very little power. Nanomix is developing new types of chemical sensors that offer exquisite levels of sensitivity and selectivity in a tiny, robust package that consumes very little power. The Nanomix carbon dioxide sensor uses carbon nanotube field-effect transistors (NTFET) as its platform for chemical sensing. Chemical functionalization of NTFET devices makes them sensitive to carbon dioxide gas and provides desired selectivity.

SUMMARY OF TECHNICAL PROGRESS

Nanomix has worked to increase their testing capability by using the Functional Test Board (FTB). The FTB is the culmination of an engineering research effort to characterize and test large numbers of functionalized NTFET devices thereby evaluating their gas sensor properties. LabView software is used to program the test and controls and monitors all aspects of the testing process. Nanomix is exploring and refining the process conditions needed to fabricate nanotube arrays on 4" silicon wafers. Different electrode geometries and carbon nanotube densities were tried in order to optimize the sensor platform in terms of CO₂ response.

Nanomix has explored different formulations of the polymeric recognition layer. Depending on the chemical composition of the polymer layer, different sensor sensitivity and long-term stability was observed. The methods of the polymer deposition were also found to have an effect on the sensor performance. Among different deposition methods, spin-coating of the polymer can produce a uniform recognition layer in a scaleable process. The initial data indicates that there is an optimum polymer thickness range for fast and stable sensor response.

Commercialization efforts include a survey of the competitive landscape to better understand demand control ventilation (DCV) product requirements and discussions with Honeywell and Trane. Honeywell has expressed strong interest in participating in the product development effort and a series of meetings and discussions are being scheduled over the next several months.

SUMMARY OF PLANNED WORK

Nanomix will perform recognition chemistry deposition on the single die level and FTB will be used to perform large-scale testing of CO₂ exposure at a total of 8 packages (~120 sensors) at a time. Database analysis of the FTB sensor tests will be developed to provide statistical information about the CO₂ sensors, including their sensitivity, response time, and long term stability. Effect of the relative humidity on the sensor performance will be studied. Recognition chemistry and the platform will continue to be optimized for sensitivity and long term stability. The FTB sensor testing data will allow selection of an optimum baseline sensor for the prototype sensor construction.

PROJECT ANALYSIS

This project is on time and within budget. No major obstacles are seen that would prevent Nanomix from successfully completing their award.

ACTION REQUIRED BY DOE HEADQUARTERS

No action is required from DOE Headquarters at this time.

STATEMENT OF WORK
DE-FG36-03GO13169
Nanomix, Inc.
Carbon Dioxide Nanoelectric Sensors

Detailed Task List

Task 1: Select Recognition Chemistry

Task 2: Optimize Sensor Structure

Task 3: Sensor Testing and Data Analysis

Task 4: Prototype Sensor Construction

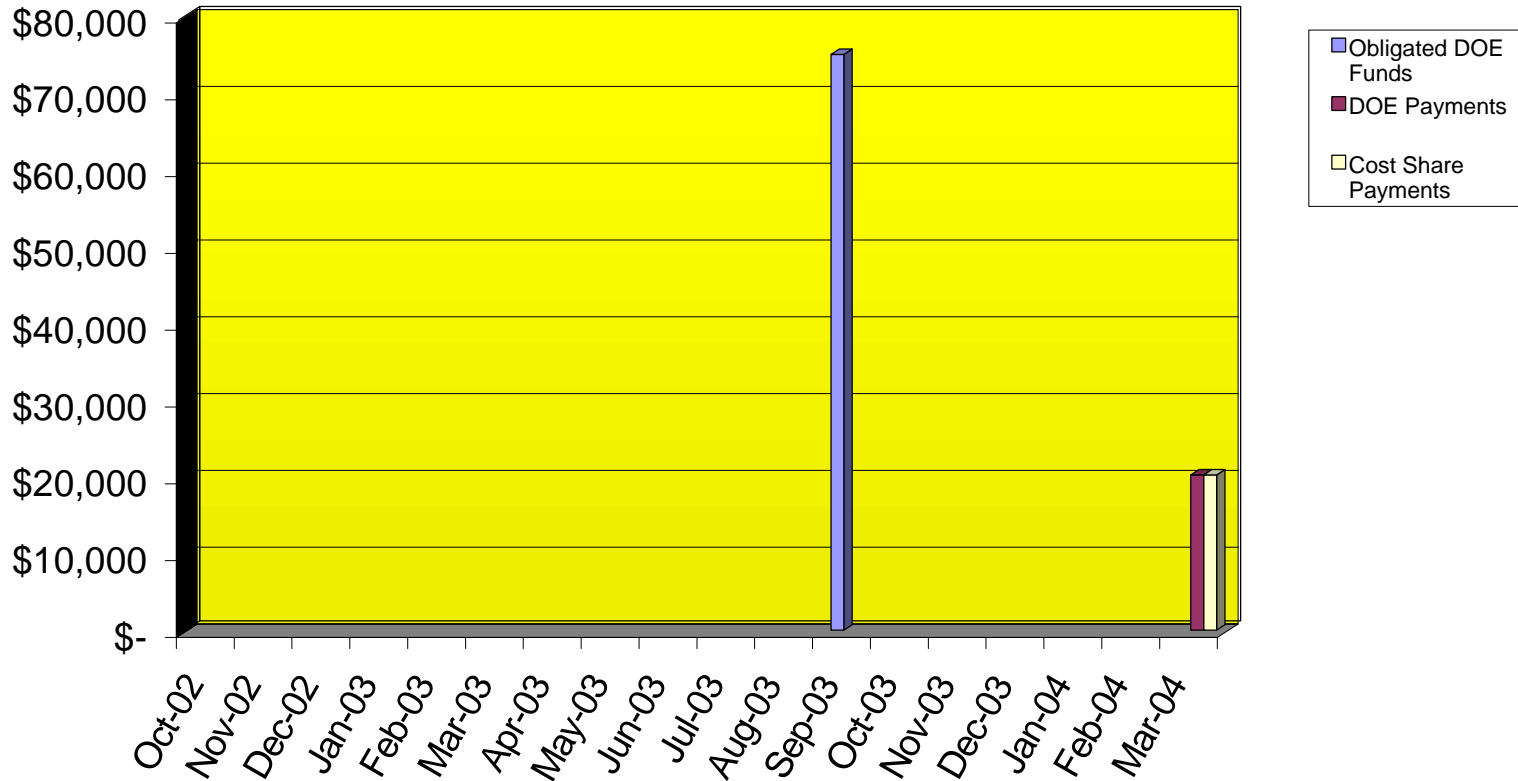
Task 5: Commercialization and Reporting

Project Cost Performance in DOE Dollars for Fiscal Year 2003

DE-FG36-03GO13169

Nanomix, Inc.

Carbon Dioxide Nanoelectric Sensors



	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03
Obligated DOE Funds	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$75,000
DOE Payment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cost Share Payment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	PFY*	Cumulative
Obligated DOE Funds	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$75,000
DOE Payment	\$0	\$0	\$0	\$0	\$0	\$20,207	\$0	\$20,207
Cost Share Payment	\$0	\$0	\$0	\$0	\$0	\$20,207	\$0	\$20,207

Approved DOE Budget:	\$75,000
Approved Cost Share Budget:	\$74,896
Total Project Budget:	\$149,896

* Prior Fiscal Years

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ID	Task Name		2004												
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	Task 1: Select Recognition Chemistry		<div><div></div></div> 80%												
2	Task 2: Optimize Sensor Structure		<div><div></div></div> 60%												
3	Task 3: Sensor Testing and Data Analysis		<div><div></div></div> 30%												
4	Task 4: Prototype Sensor Construction		<div><div></div></div> 0%												
5	Task 5: Commercialization and Reporting		<div><div></div></div> 10%												